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Forensic Engineering and Visualization

4215.Goodnight
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Report

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Case Name: Waterdown v. Mesilla Valley
Date of Incident: May 13, 2018

Mr. Goodnight:

As requested, Kineticorp investigated a multiple vehicle incident that occurred at 8:41 AM on May 13, 2018, at the intersection of U.S. Highway 412 and County Road 4115 in Rogers County, Oklahoma. The incident involved a 2015 International ProStar, driven by Dagoberto Chavez, and a 2007 Ford F-150, driven by Matthew Waterdown, with passengers Charlie Waterdown and Sherry Waterdown. According to the Oklahoma Traffic Collision Report (Case Number: B01085-18), "Units 1 and 2 were Eastbound on U.S. Highway 412. Driver of Unit 1 stated that he had pulled over on the shoulder to check his location. Unit 1 then attempted to turn left through a cut-through and was subsequently struck by unit 2 who swerved to the left in an attempt to avoid contact[1]."

Procedure: In conducting the investigations, provided photographs and videos were used in conjunction with the police report to analyze the incident. In addition, Kineticorp inspected and investigated the incident scene and reviewed the provided documents listed in Appendix A.

Findings and Discussion: Based on Kineticorp's investigation and analysis, the following was determined:

Incident Site: The police report states that the incident location was at the intersection of U.S. Highway 412 and County Road 4115 in Rogers County, Oklahoma. In the area of the collision, U.S. Highway 412 is a roadway supporting two travel lanes in both east and westbound directions, separated by a grass median. The travel lanes at the incident scene are approximately 12 feet wide, with paved shoulders bordering both sides. Northbound and

[1] Official Oklahoma Traffic Collision Report, Case Number: B01085-18, p. 4

southbound turn lanes are present. The speed limit on U.S. Highway 412 in the incident area is 65 mph. An image of the incident location is shown in Figure 1.

Figure 1 - Incident Location (Google 3/12/2018)

A Google Streetview image looking eastbound on U.S. Highway 412 near the impact area is shown in Figure 2, which includes the roadway and lane configurations near the incident location.

Figure 2 – Google Streetview (7-2019) Looking Eastbound on U.S. Highway 412

A Google Streetview image looking westbound on U.S. Highway 412 near the impact area is shown in Figure 3.

Figure 3 – Google Streetview (7-2019) Looking Westbound on U.S. Highway 412

Scene Inspection: On April 16, 2021, Kineticorp performed a scene inspection on the incident site. Figure 4 is a photograph taken at the time of the inspection looking eastbound on U.S. Highway 412 near the intersection with County Road 4115.

Figure 4 - Kineticorp Scene Inspection Looking Eastbound on U.S. Highway 412

Kineticorp also performed a 3D laser scan survey of the scene. A total of five scans were performed with more than 100 million points of data obtained. An image of the scaled 3D model created from the laser scans is shown in Figure 5, oriented so that the eastbound travel direction is from the bottom right to the top left.

Figure 5 - Kineticorp Scene 3D Laser Scan

Vehicles: The following details the vehicles involved in the incident including vehicle identification, specifications, and, if present, relevant damages.

2015 International ProStar: Vehicle 1 in this incident, as designated by the Oklahoma police report, is a 2015 International ProStar, driven by Dagoberto Chavez. The International, bearing the VIN - 3HSDJSNR7FN058230, is a 6x4 truck tractor with a 12.4L 6 cylinder Navistar N13 diesel engine.

Figure 6 – Subject 2015 International ProStar

Utility Semi-Trailer: Vehicle 1 in this incident, the 2015 International ProStar, was pulling a Utility semi-trailer. The Utility trailer is a box van trailer of 53 feet total length with tandem axles. The center of the trailer had visible contact damage, including dents and tears to the driver's side trailer wall. The provided police photographs in Figure 7 show the damages to the subject Utility semi-trailer.

Figure 7 – Subject Utility Semi-Trailer Damages

2007 Ford F-150: Vehicle 2 in this incident, as designated by the Oklahoma police report, is a 2007 Ford F-150, driven by Matthew Waterdown. The 2007 Ford, bearing the VIN - 1FTPX12V57FA39344, is a passenger vehicle with a 5.4L V8 engine. The Ford had contact damage to the front, including the hood, windshield, roof, and other body panels. The roof

was cut off after the incident to assist in passenger extrication. The photographs in

Figure 8 show damages to the Ford from provided police photographs.

Figure 8 – Subject 2007 Ford F-150 Damages

Camera Matching Photogrammetry: After generating a scaled three-dimensional environment of the incident site as well as 3D models of both subject and exemplar vehicles (International tractor and Utility semi-trailer, 2007 Ford), Kineticorp then used camera-matching photogrammetry to analyze photographs taken of the incident site and subject vehicles to determine the locations of physical evidence in provided police photographs. The physical evidence identified and located using photogrammetry was inserted in Kineticorp's scene diagram. Photogrammetry is a process that uses principles of perspective to analyze and obtain three-dimensional data from photographs or video. These principles and techniques are widely accepted and used within the field of incident reconstruction and computer visualization[2,3,4,5,6].

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[2] Fenton, S., Neale, W., Rose, N., Hughes, C., "Determining Crash Data Using Camera-Matching Photogrammetric Technique," Paper Number 2001-01-3313, Society of Automotive Engineers, 2001.

[3] Pepe, Michael D., et al., "Accuracy of Three-Dimensional Photogrammetry as Established by Controlled Field Tests," Society of Automotive Engineers Paper Number 930662.

[4] Brach, Raymond M., et al., Vehicle Incident Analysis and Reconstruction Methods, "Chapter 10: Photogrammetry," Society of Automotive Engineers, 2005.

[5] Rucoba, R., Duran, A., Carr, L., "A Three Dimensional Crush Measurement Methodology Using Two-Dimensional Photographs." Society of Automotive Engineers Paper Number 2008-01-0163.

[6] Terpstra, T., Voitel, T., Hashemian, A., "A Survey of Multi-View Photogrammetry Software for Documenting Vehicle Crush." SAE, Paper 2016-01-1475, Society of Automotive Engineers, 2016.

The photogrammetric process involves aligning the computer model with photographs such that the position and characteristics of the camera that took the image are matched in the computer environment with a computer-generated camera. Figure 9 and Figure 10 show provided police photographs of the incident site matched with the 3D laser scans captured by Kineticorp, which allows for accurate extraction and location of physical evidence in the 3D computer environment.

Figure 9 - Camera Matching Process (00-PhotosCombined_Page_010.jpg)

Figure 10 - Camera Matching Process (00-PhotosCombined_Page_018.jpg)

Analysis: In evaluating this collision, Kineticorp analyzed the sequence of events using the completed 3D environment of the scene, including camera-matched physical evidence shown in provided photographs. Kineticorp also analyzed the damage to the subject vehicles to determine the impact configuration of the collision. Kineticorp then performed an analysis of the vehicles' speeds and paths of travel prior to impact and determined the recognition distance as well as a perception-reaction time (PRT) for Mr. Waterdown. The methods,

processes, and procedures used by Kineticorp in reconstructing this crash are widely accepted and utilized in the accident reconstruction community.

Physical Evidence: Inspection of the provided police photographs show a set of tire marks leading into the side of the tractor trailer. The tire marks shown in the photographs are consistent with the police report stating the Ford swerved to the left in an attempt to avoid the collision. The tire marks can be seen in Figure 11, outlined in a camera-matched provided police photograph.

Figure 11 - Tire Marks in Impact Area

The camera matched tire marks were then positioned into the scaled accident scene, the complete 3D incident scene diagram including all physical evidence surrounding the area of impact is shown from an aerial perspective in Figure 12.

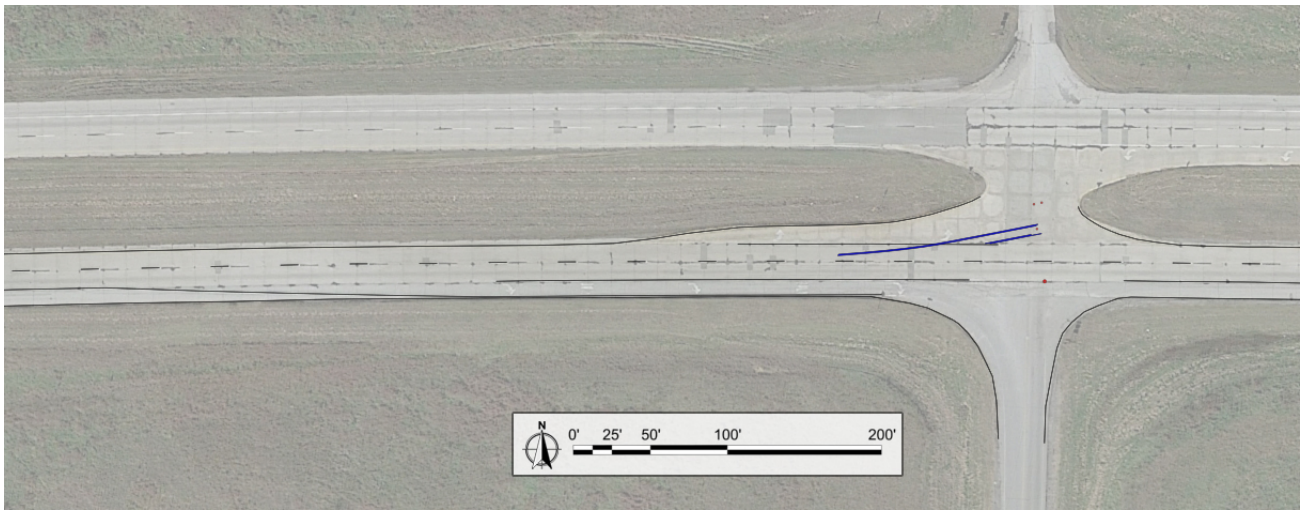

Figure 12 - Kineticorp Scene Diagram with Camera-Matched Physical Evidence

As seen in Figure 12, the tire marks deposited by the left (driver's) side of the Ford's begin within the right travel lane and then angle towards the center of the intersection. A tire mark from the right (passenger's) side of the Ford can be seen closer to the point of impact.

Video-Tracking Analysis: In addition to provided photographs, extracted images from the International's provided DriveCam video were used for photogrammetric analysis. DriveCam analysis is the process of using provided incident video to determine vehicle speeds and positions and is a commonly used form of analysis in the field of accident reconstruction. The analysis shows that the International was traveling approximately 10 to 15 mph at impact. Figure 13 shows extracted video frames matched with the 3D laser scans captured by Kineticorp, allowing for incremental positioning of the tractor throughout the incident sequence.

Figure 13 - Camera Matching Process, Extracted Video Frames (frame-101.jpg)

Impact Configuration: To determine the impact configuration between the Ford and the Utility trailer, an analysis was performed using the damages to the vehicles. The Utility trailer has damage on the left (driver) side that correspond to specific damage locations on the Ford. The most severe damage was located on the left side near the middle of the Utility trailer, as seen in police photographs in Figure 14.

Figure 14 - Subject Utility Trailer Damage

The left (driver) trailer wall shows multiple dents and a tear in the trailer skin resulting from the impact with the Ford. In addition, the trailer side skirt was also pushed inwards during the collision.

Mr. Waterdown's Ford had contact damage focused on the front end, with damage to the front windshield, driver's side wheel, roof, A-pillar, and other body panels. The Ford's roof was removed post-impact to assist in passenger extrication. Damage to the Utility trailer wall and side skirt correspond to damage to the hood, roof, and windshield of the Ford, indicative of an underride collision. Furthermore, provided photographs show the Ford partially underneath the side of the Utility trailer post-impact.

Provided photographs along with physical evidence and damage locations on the subject Utility trailer and Ford were used to locate the International tractor, Utility trailer, and Ford at the time of impact relative to the roadway. The impact configuration was positioned into the 3D scene diagram and oriented based on the Ford's initial tire marks and the locations of both vehicles in provided photographs and videos. Figure 15 shows the impact configuration in the scene diagram.

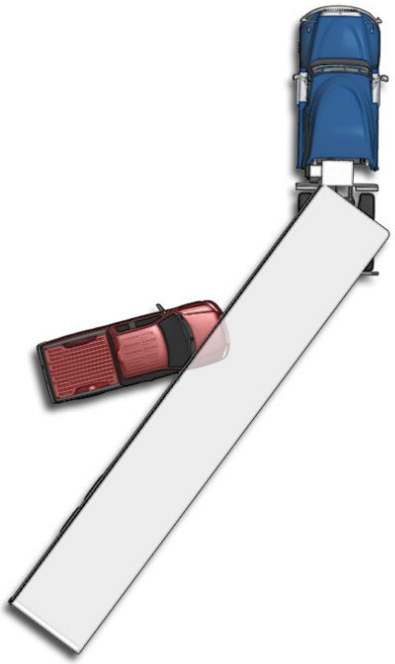

Figure 15 – Impact Configuration

Impact Speed Analysis: After the impact configuration was determined, the closing speed between the International tractor and Mr. Waterdown's Ford was analyzed through conservation of energy and video analysis.

The average speed of the tractor-trailer was calculated using the Drive Cam video, which results in speeds and positions of the International leading up to the point of impact. The analysis showed that the International was traveling approximately 10 to 15 mph at impact. Also, the video recorded audio, which captured the screeching tires of the Ford at approximately 1.8 to 2.0 seconds before impact. Utilizing the DriveCam video analysis, the time and position of impact, and the Ford's pre-impact braking, it was determined that the Ford was traveling approximately 65 mph prior to braking and 36 mph at impact.

Time-Space Analysis: Time-space analysis was performed to determine the pre-impact positions and speeds of the Ford and International tractor-trailer. The analysis shows at the time the International began to turn to the left, the Ford was approximately 484 feet from the point of impact. In Figure 16, each position of the Ford corresponds the position of the International Tractor and Utility trailer. The darker colored vehicles in Figure 16 shows the positions of the vehicles when the International began to make the left turn maneuver.

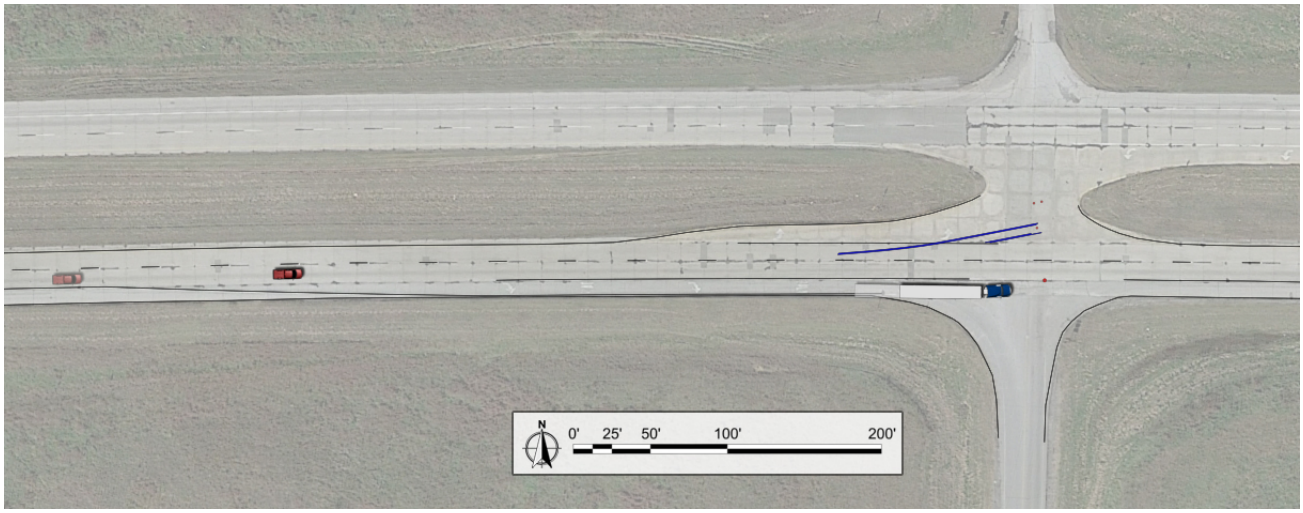

Figure 16 - International Starts to Turn Left (484 feet and 5.5 seconds before impact)

The analysis also showed the Ford started to swerve to the left from the right lane approximately 2.7 seconds after the tractor began to turn left. When the Mr. Waterdown began to swerve left, the Ford was approximately 225 feet from the point of impact. Figure 17 shows the position of the Ford and International/Utility trailer at the beginning of the swerve maneuver.

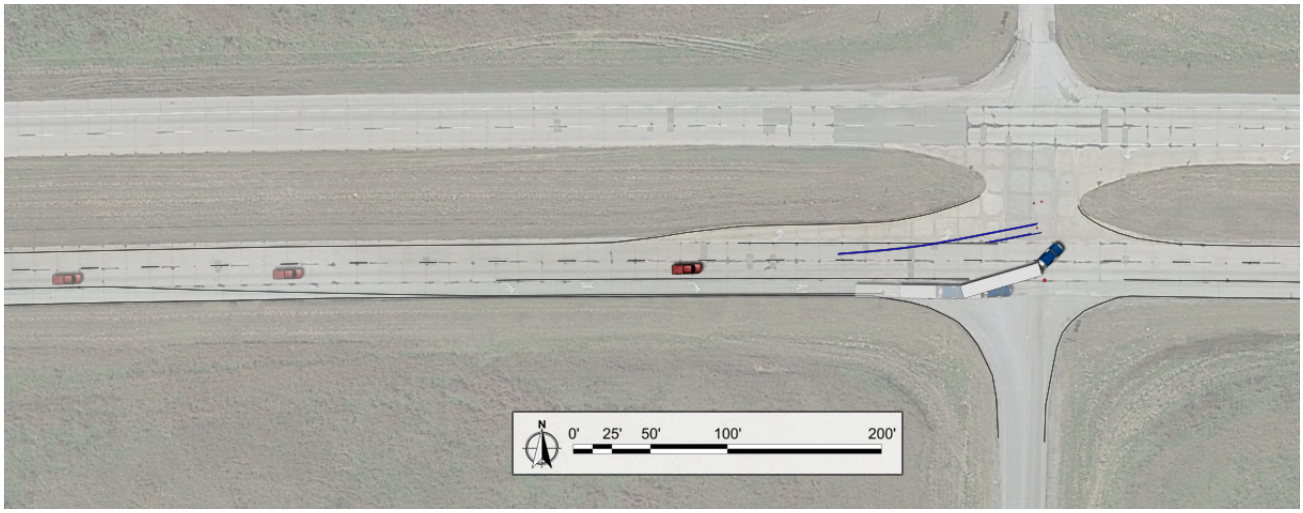

Figure 17 - Ford Start of Swerve (Ford 225 ft and 2.8 seconds before impact)

The time elapsed from the beginning of the turn of the International to the steering response by Mr. Waterdown was approximately 2.7 seconds. Perception-reaction time research performed by Jeff Muttart shows that the average response time is approximately 1.6 seconds, with 85% of people reacting within 2.2 seconds[7]. The reaction time of Mr. Waterdown of 2.7 seconds was approximately 0.5 seconds slower than the 85th percentile response. Therefore, the Mr. Waterdown had a longer perception-reaction time than what would be expected 85% of drivers.

After Mr. Waterdown began to swerve, the Ford continued to travel for approximately 93 feet before the start of the tires marks deposited on the roadway. At the start of the tire marks,

[7] Crash Safety Solutions Interactive Driver Response Research Software Version 2021.1

the Ford was approximately 1.8 seconds and 131 feet from the point of impact. Figure 18 shows the location of the Ford at the beginning of the tire marks and the location of the International tractor. Furthermore, the 1.8 seconds is also consistent with the tire screeching sounds recorded by the Drive Cam video.

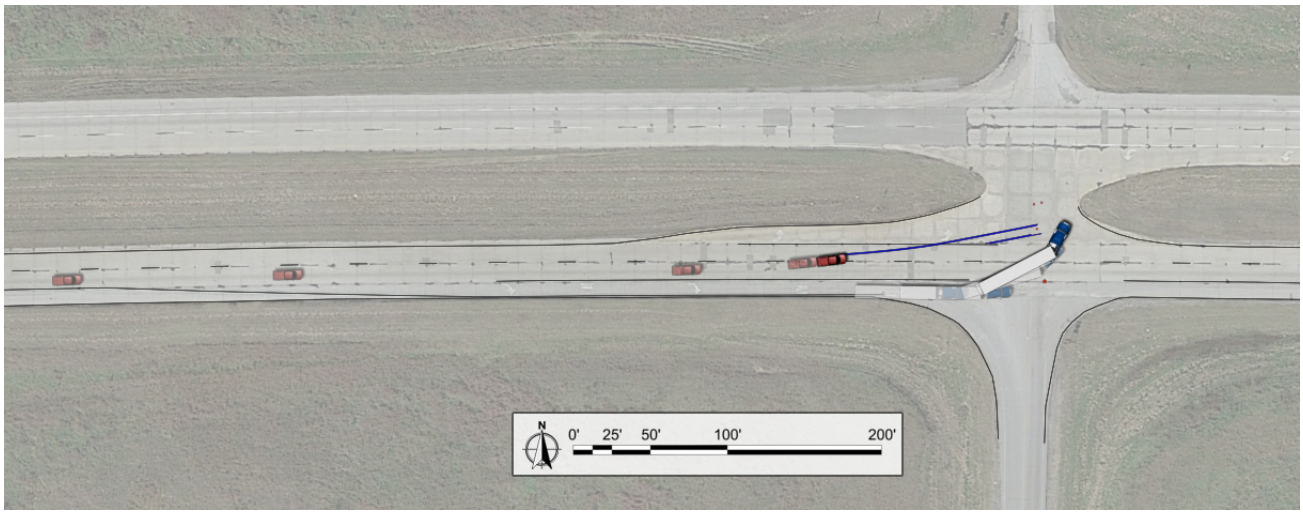

Figure 18 – Location of Ford 2 Seconds (150 ft) Prior to Impact

Avoidance: An analysis was performed to determine whether or not the Ford could have avoided the collision with the tractor-trailer had Mr. Waterdown reacted with the 85th percentile PRT of 2.2 seconds, and not 2.7 seconds as determined from accident time-space analysis. When analyzing this scenario, the Ford still swerved and still decelerated at the same rate, but with a reaction time 0.5 seconds faster and braking at the beginning of the swerve. Under this scenario, the Ford would have stopped approximately 63 feet prior to the point of impact. Therefore, had Mr. Waterdown reacted with an 85% PRT and began braking at the start of the swerve, the accident would have been avoided. Furthermore, had Mr. Waterdown reacted with an average PRT of 1.6 seconds, the Ford would have stopped 120 feet from the point of impact.

Another source describing drivers' perception/reactions times as well as stopping distances is the Oklahoma Driver's Manual. The 2017 Oklahoma Driver's Manual (Chapter 9) labeled "Stopping and Following", states, as an example, "it will take 1.16 seconds for you to see the deer and move your foot to the brake." The section also shows a table breaking down the Perception time as 0.5 seconds and a Reaction time of 0.66 seconds for a total PRT of 1.16 seconds. According to the manual, this equates to a 132-foot driver reaction distance at 60 mph and 154 feet at 70 mph. With the Ford traveling about 65 mph that would equate to a driver reaction distance of 143 feet.

Under that same section in Chapter 9, the Oklahoma Driver's Manual also discusses braking distances. According to the manual, a vehicle traveling 60 mph would take 120-240 feet to stop, and 163-327 feet for a vehicle at 70 mph. Averaging the distances for a vehicle traveling 65 mph shows that the vehicle would need 142 to 284 feet to stop. Combining the braking distance with the 1.16 second PRT distance of 143 results in a total distance of 285 to 427 feet for a vehicle traveling 65 mph. When the International began to make the left turn maneuver, the Ford was 484 feet from the point of impact. Therefore, had Mr. Waterdown reacted and applied braking, as outlined in the Oklahoma Driver's Manual, the Ford would have stopped 57 to 199 feet short of the point of impact and avoided the impact.

Conclusions: Based on the available evidence and this engineer's training, education, and experience, the following conclusions were reached:

- The speed of the Ford prior to braking was 65 mph.
- The speed of the Ford at impact was approximately 36 mph.
- The speed of the International tractor and Utility trailer at the time of impact was between 10 and 15 mph.
- Mr. Waterdown's perception-reaction time to the International's left-turn maneuver was 2.7 seconds.
- The average perception-reaction is 1.6 seconds, with 85% of drivers reacting within 2.2 seconds.
- At the time the International started to turn to the left, the Ford was approximately 484 feet and 7.0 seconds from impact.
- The Ford began to swerve approximately 225 feet and 2.8 seconds prior to impact.
- The Ford was approximately 131 feet and 1.8 seconds from impact at the start of the tire marks.
- Had Mr. Waterdown reacted in 2.2 seconds, not 2.7 seconds, and began braking at the beginning of the swerve, the accident would have been avoidable, with the Ford stopping 63 feet short of impact.
- According to the 2017 Oklahoma Driver's Manual, Mr. Waterdown should have been able to stop his vehicle in 285-427 feet, which is 57-199 feet short of the point of impact.

Closing: The opinions and conclusions expressed in this report were reached to a reasonable degree of engineering certainty and are based on the evidence available to this engineer as of the date of this report. This engineer reserves the right to amend and/or supplement the conclusions contained within this report as additional information becomes available.

Sincerely,

KINETICORP, LLC.

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David A. Danaher, P.E.

Principal Engineer

ACTAR #976

NAFE Fellow

Appendix A:
List of Provided Documents

- **Police**
  - Accident Report
  - citation
  - citation 2
  - Event detail
  - wrecker storage_Redacted

- **Photographs**
  - 00-PhotosCombined (119 Photos – Accident Scene)

- **Video**
  - Truck 1507 DOL 05-13-2018 TN X1
  - Truck 1507 DOL 05-13-2018 TN x2

- **Technical Information**
  - Ford RCM-Airbag Tech 2 Data
  - 1FTPX12V57FA39344_PCMV22007FordF150

- **Legal Documents**
  - B01085-18

List of Additional Documents

- **Other Documents**
  - CHADAG 05.06.18 TO 05.13.18 PAPER LOGS_
  - CHAERI 05.06.18. TO 05.13.18 PAPER LOGS_
  - Final Report 2018-08-20
  - lab report